400425

FLOOD INSURANCE STUDY

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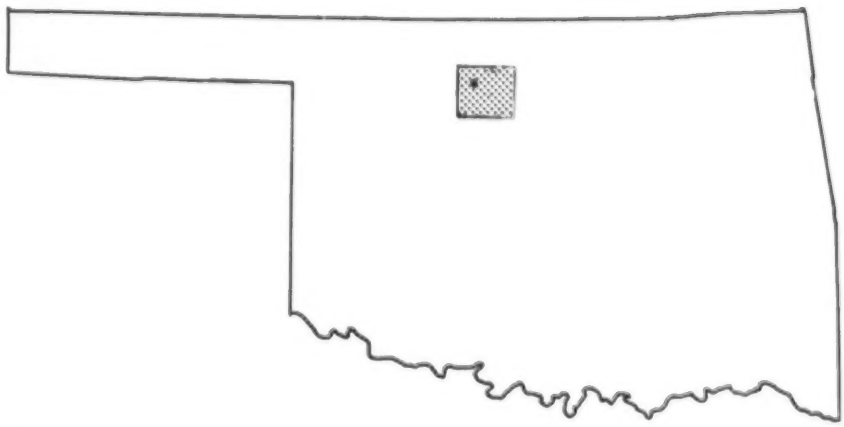
TOWN OF NORTH ENID
OKLAHOMA
GARFIELD COUNTY



OCTOBER 1, 1980

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COMMUNITY NUMBER - 400425

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PUBLISHED SEPARATELY:

Flood Insurance Rate Map	Panel 0001

FLOOD INSURANCE STUDY
TOWN OF NORTH ENID, OKLAHOMA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Town of North Enid, Garfield County, Oklahoma, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert North Enid to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these Federally-supported studies are based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 24 CFR, 1910.1 (d). In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Geological Survey (USGS) for the Federal Insurance Administration, under Interagency Agreement No. IAA-H-9-77, Project Order No. 25. This study was completed in October 1978.

1.3 Coordination

The initial coordination for this community was done in conjunction with the City of Enid in 1975. A final community coordination meeting was held August 14, 1979, to discuss the results of the study. Representatives from the FIA, the USGS and the Town of North Enid attended the meeting.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the Town of North Enid, Garfield County, Oklahoma. The area of study is shown on the Vicinity Map (Figure 1).

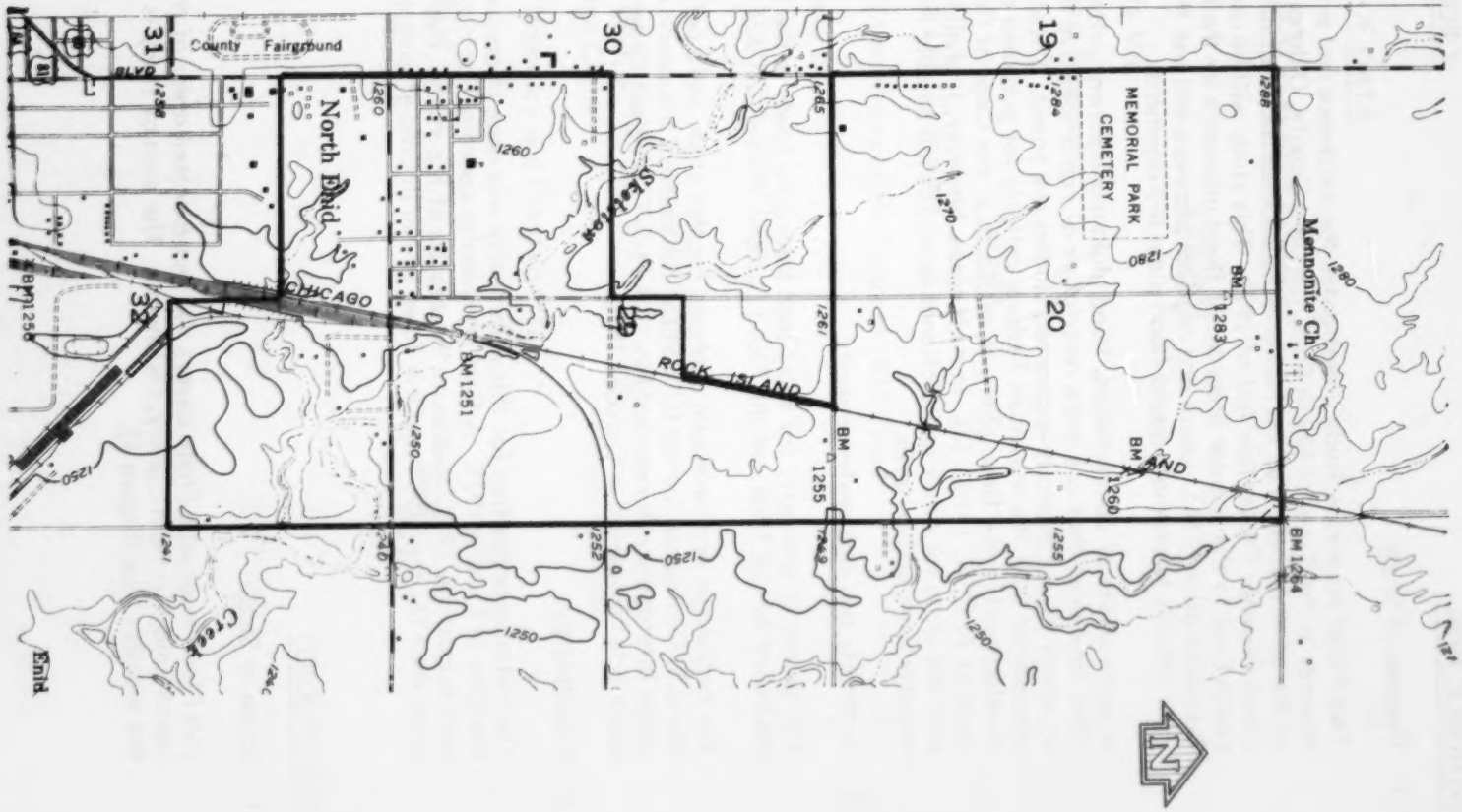


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWN OF NORTH ENID, OK
(GARFIELD CO.)

APPROXIMATE SCALE
2000 0 2000 4000 8000 FEET

VICINITY MAP

Skeleton Creek was the only stream studied as determined in the initial coordination meeting. Skeleton Creek was studied by detailed methods through North Enid.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, and areas of projected development or proposed construction for the next five years, through 1983.

2.2 Community Description

The Town of North Enid, in west-central Garfield County, in north-central Oklahoma is surrounded by the City of Enid, the county seat. The nearest major city, other than Enid, is Oklahoma City, located approximately 65 miles south of North Enid.

The area is primarily agricultural, with winter wheat and beef cattle as the prevailing products. Petroleum is also a very significant factor in the area's economy, providing opportunities for small, related industries.

The town lies in a gradually rolling plains county. It has a mild, semi-arid climate. The mean annual temperature is 60 degrees F with an average frost-free period of 214 days. The average annual rainfall is 29 inches (Reference 1). Numerous short, intense thunderstorms occur during the spring, summer and early fall, which result in frequent flooding. Most streams in the area have steep, incised low-water channels and wide, flat flood plains, which cause extensive inundation during flood stage. The drainage in the city flows generally southeasterly with Skeleton Creek and tributaries forming the drainage features.

2.3 Principal Flood Problems

Short, intense thunderstorms have been the cause of flooding in North Enid, because the area was settled in the late 19th century only recent floods have been recorded.

Major floods occurred in North Enid and neighboring communities in June 1923, August 1923, July 1950, May 1957 and October 1973. The flood of October 1973 is the largest known, and the most recent in the area. It had an estimated recurrence interval of more than 500 years. An area of approximately 500 square miles received more than 10 inches of rainfall, and an area of approximately 100 square miles received from 15 to 20 inches of rain during this storm. The National Weather Service station at Enid recorded 15.68 inches of rainfall in 13 hours, 12 inches of which fell in a 3 hour period. The maximum hourly rainfall intensity was 5.3 inches per hour (Reference 2).

2.4 Flood Protection Measures

No flood protection measures presently exist. Flood detention structures upstream have been comtemplated for the future.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, and 500-year period (recurrence intervals), have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one percent chance of annual occurrence) in any 50 year period is about 40 percent (four in 10), and for any 90 year period, the risk increases to about 60 percent (six in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail in the community.

Peak-discharge for the 10-, 50-, and 100-year recurrence intervals were computed using equations established by a statistical analysis relating selected basin characteristics to streamflow records of streams in Oklahoma and neighboring states (Reference 3). Adjustments were made to the computed discharges to account for urbanization within the basin (Reference 4).

The peak discharge-drainage area relationships for the selected recurrence intervals are presented in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR*
SKELETON CREEK					
16th Street	7.0	1,920	3,970	4,880	
Purdue Avenue	5.6	1,630	3,360	4,120	

*Historical flood profile of October 1973 used, therefore no discharge computation is necessary.

Discharge for the 500-year flood was not computed for this study; instead, the historical flood profiles surveyed in October 1973 were used as the 500-year flood, even though the flood was in excess of the 500-year flood (Reference 2). Relatively small changes in water-surface elevations occur with changes in discharge at large flows such as a 500-year flood. The statistical analysis related to the computations of the 500-year flood has significant errors associated with it. Therefore, routing a computed 500-year flood was considered to be less accurate than the profile of the naturally occuring flood. Elevations of the highwater marks of the October 1973 flood are given in Table 2.

TABLE 2 -- HIGHWATER MARKS OF THE OCTOBER 1973 FLOOD

SKELETON CREEK

Distance above Southgate Road (feet)	Elevation (Feet NGVD)	Description
4,000	1244.3	Downstream from Purdue Ave.
4,300	1244.6	Upstream from Purdue Ave.
5,150	1246.5	Upstream from Purdue Ave.
5,310	1245.2	Upstream from Purdue Ave.
11,480	1247.1	Upstream from Purdue Ave.
11,590	1263.4	Downstream of northbound lane, U.S. 81
11,700	1262.0	Downstream of northbound lane, U.S. 81

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the flood sources.

Cross section data for the streams in the study area were obtained by field surveys. All bridges and culverts were field surveyed to obtain elevation data and structural geometry. Cross sections were located at close intervals upstream and downstream of bridges and culverts in order to compute significant backwater effects of these structures. The locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For streams for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Roughness coefficients (Manning's "n") for the computations were estimated on the basis of field inspection and from flood measurements made in October and November 1973. The roughness coefficients ranged from 0.025 to 0.050 for the main channel and 0.030 to 0.080 for the overbank areas.

Water-surface elevations of floods of the 10-, 50-, and 100-year recurrence interval were computed using the USGS step-backwater computer program (Reference 5 and 6). The 500-year recurrence interval flood profiles were determined using historical data supplemented by the step-backwater program (Reference 2).

The starting water-surface elevations for Skeleton Creek were obtained using the slope-conveyance method. The study started from station "A" which is 1880 feet downstream of the corporate limits (16th Street).

All elevations used in this study are referenced to National Geodetic Vertical Datum of 1929 (NGVD); the elevation reference marks used in this study are shown and described on the maps.

Flood elevations in the community may be raised by debris blockages of the streams in the study area. The hydraulic analyses for this study, however, are based only on the effect of unobstructed flow. The flood elevations as shown on the profiles are thus considered valid only if hydraulic structures in general remain unobstructed and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and the 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topograhic maps at a scale of 1 inche = 500 feet with a contour interval of 10 feet. In cases where the 100- and the 500-year flood boundaries are close together, only the 100-year boundary has been shown.

For the streams not covered by detailed study, approximate 100-year flood boundaries were transferred from FIA Flood Hazard Boundary Map for the Town of North Enid (Reference 7).

The boundaries of the 100- and 500-year flood are shown on the Flood Boundary and Floodway Map. Small areas within the flood boundaries may lie above the flood elevations, and therefore, may not be subject to flooding. Owing to limitations to the map scale and/or lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood may be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed (Table 3). As shown on the Flood Boundary and Floodway Map, the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood boundary are the same, the 100-year flood boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Skeleton Creek								
A	0	200/0	983	4.96	1228.5	1228.5	1229.5	1.0
B	2,045	224/224	1,485	3.29	1234.0	1234.0	1234.9	0.9
C	3,215	249/249	1,343	3.63	1234.9	1234.9	1235.7	0.8
D	3,485	95/95	664	7.35	1235.3	1235.3	1235.9	0.6
E	3,965	90/90	595	6.93	1236.9	1236.9	1237.5	0.6
F	4,060	472/472	2,776	1.48	1243.9	1243.9	1243.9	0.0
G	5,155	110/110	941	4.38	1244.2	1244.2	1244.2	0.0
H	5,895	255/255	1,902	2.17	1245.2	1245.2	1245.7	0.5
I	6,555	138/138	873	4.72	1246.8	1246.8	1247.3	0.5
J	7,775	208/208	1,206	3.42	1250.3	1250.3	1251.3	1.0
K	9,405	400/0	1,063	3.87	1254.1	1254.1	1254.5	0.4

[1]Feet above downstream limit of detailed study
[2]Total floodway width/width within corporate limits

TABLE 3

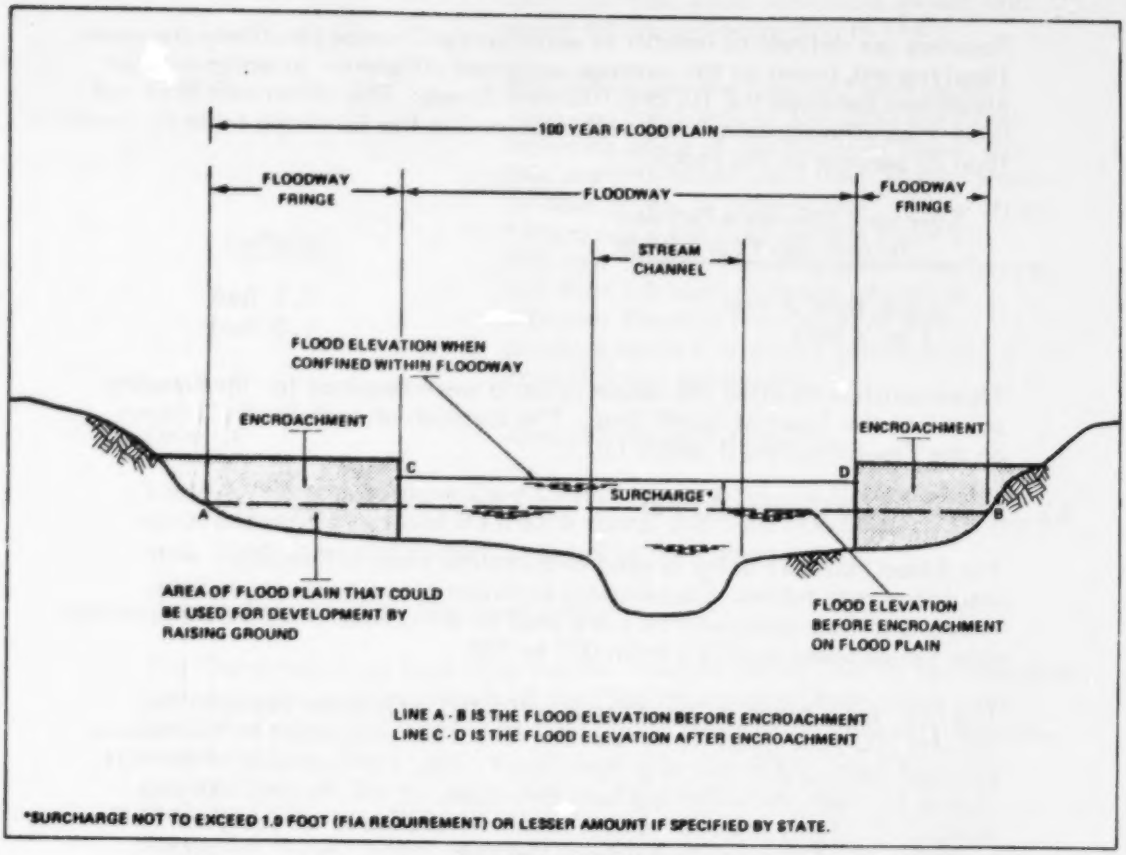
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWN OF NORTH ENID, OK

(GARFIELD CO.)

FLOODWAY DATA

SKELETON CREEK


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC Figure 2

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each significant flooding source affecting the Town of North Enid.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot

Three reaches meeting the above criteria were required for the flooding source of the Town of North Enid. The location of each reach is shown on the Flood Profiles (Exhibit 1).

5.2 Flood Hazard Factors (FHFs)

The Flood Hazard Factor is used to correlate flood information with insurance rate tables. Correlations between property damages from floods and their assigned FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between the water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, the accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of North Enid was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations.

Zone A: Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.

Zones A3,A4,A9:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; or areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 4, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Town of North Enid is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

A Flood Insurance Study of Enid has been conducted and this study matches it (Reference 7). No other studies have been prepared on Skeleton Creek that are more extensive than an isolated structural design.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, 911 Walnut Street, Kansas City, Missouri 64106.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3]
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Skeleton Creek							
Reach 1	0001	-1.56	-0.43	+4.10	015	A3	Varies
Reach 2	0001	-4.26	-0.55	+2.87	045	A9	Varies
Reach 3	0001	-1.80	-0.43	+4.66	020	A4	Varies

[1] FLOOD INSURANCE RATE MAP PANEL
[2] WEIGHTED AVERAGE
[3] ROUNDED TO NEAREST FOOT – SEE MAP

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWN OF NORTH ENID, OK

(GARFIELD CO.)

FLOOD INSURANCE ZONE DATA

SKELETON CREEK

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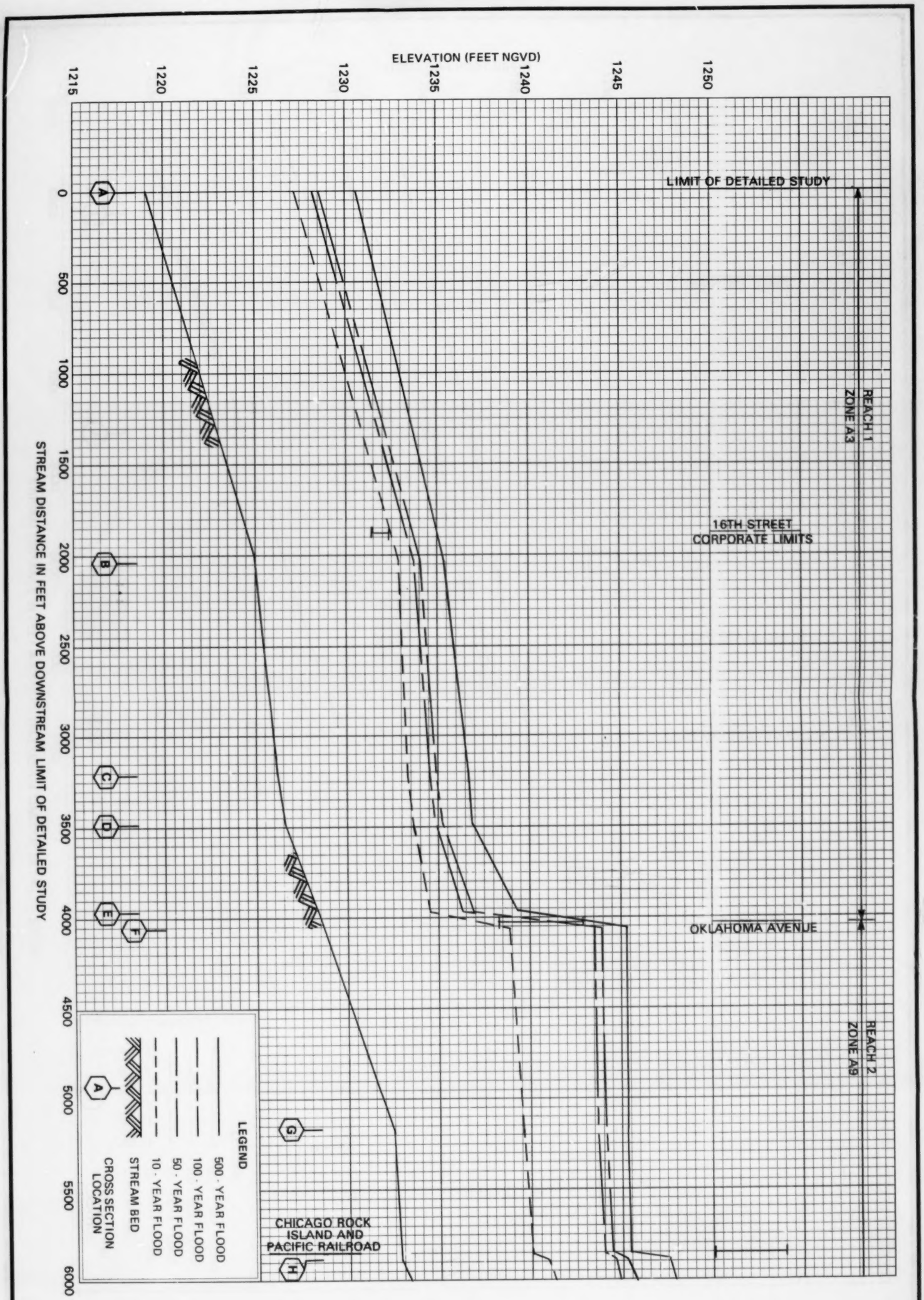

FEDERAL EMERGENCY MANAGEMENT AGENCY
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TOWN OF NORTH ENID, OK
(GARFIELD CO.)

FLOOD PROFILES

SKELETON CREEK

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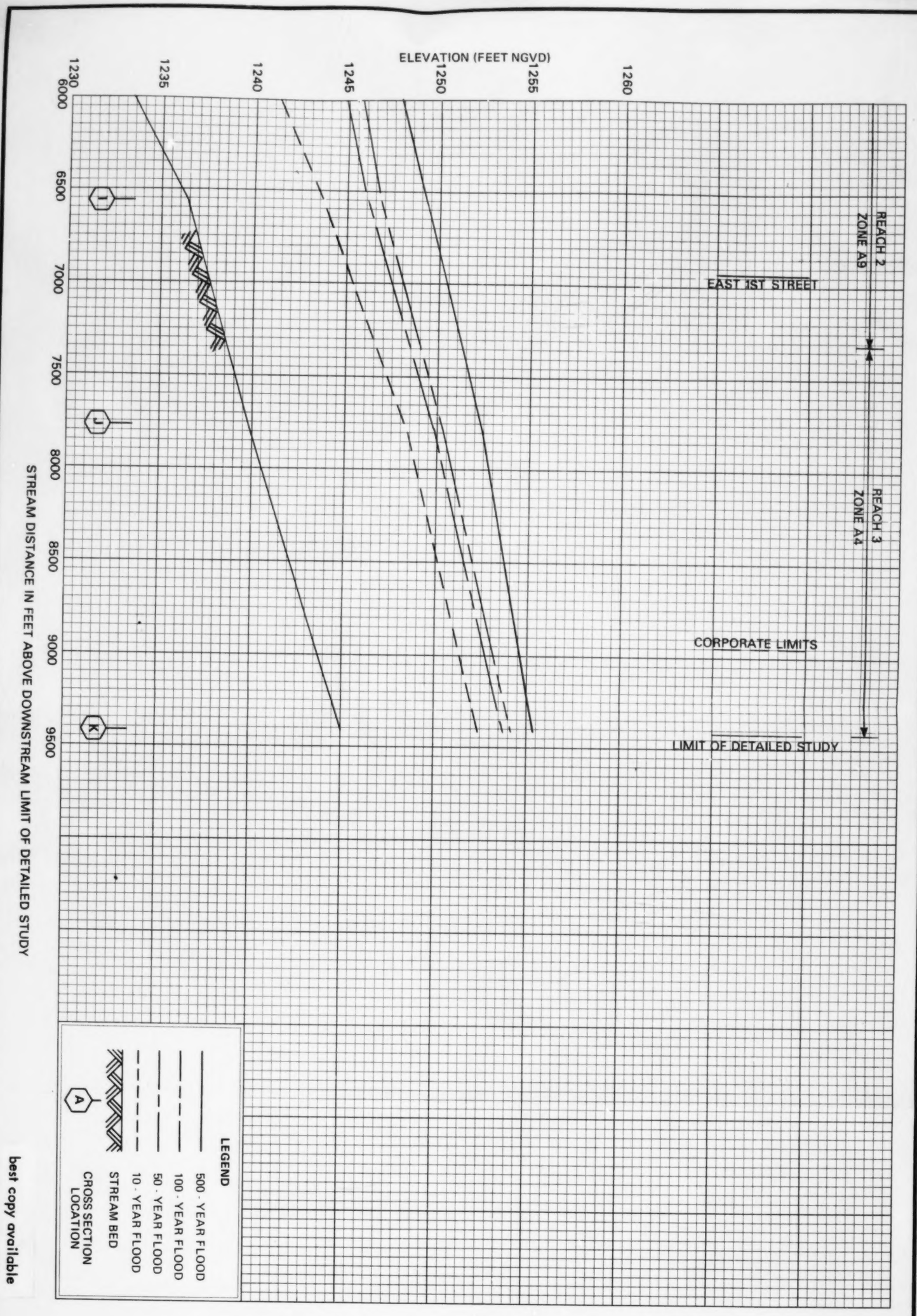

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FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWN OF NORTH ENID, OK
(GARFIELD CO.)

FLOOD PROFILES

SKELETON CREEK